INVESTOR IN PEOPLE

The Patent Office
Concept House
Cardiff Road
Newport
South Wales
NP10 8QQ

I, the undersigned, being an officer duly authorised in accordance with Section 74(1) and (4) of the Deregulation & Contracting Out Act 1994, to sign and issue certificates on behalf of the Comptroller-General, hereby certify that annexed hereto is a true copy of the documents as originally filed in connection with the patent application identified therein.

In accordance with the Patents (Companies Re-registration) Rules 1982, if a company named in this certificate and any accompanying documents has re-registered under the Companies Act 1980 with the same name as that with which it was registered immediately before re-registration save for the substitution as, or inclusion as, the last part of the name of the words "public limited company" or their equivalents in Welsh, references to the name of the company in this certificate and any accompanying documents shall be treated as references to the name with which it is so re-registered.

In accordance with the rules, the words "public limited company" may be replaced by p.l.c., plc, P.L.C. or PLC.

Re-registration under the Companies Act does not constitute a new legal entity but merely subjects the company to certain additional company law rules.

Signed R. Mahoney

Dated 2 September 2003

Patents Form 1/77

Patents Act 1977
(Rule 16)

The Patent Office

19SEP02 E749323-2 D02094
P01/7700 0.00-0221687.7

Request for grant of a patent

THE PATENT OFFICE
E
18 SEP 2002
LONDON

1/77

The Patent Office

Cardiff Road
Newport
Gwent NP9 1RH

1.	Your reference	02 41910
2.	Patent application number	0221687.7 18 SEP 2002
3.	Full name, address and post code of the or each applicant	Joseph Anthony Griffiths Mid Trees Lythe, Lythe Hill Estate Petworth Road Hazlemere, Surrey
	Patents ADP number	8467149 0001
	If the applicant is a corporate body, give the country/state of its incorporation	
4.	Title of the invention	HIGH G OXYGEN MASK FOR AIRCREW
5.	Name of your agent	VENNER, SHIPLEY & CO
	"Address for service" in the United Kingdom to which all correspondence should be sent	20 LITTLE BRITAIN LONDON EC1A 7DH
	Patents ADP	1669004
6.	If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or each of these earlier applications and the or each application number	Country / Priority application number / Date of filing
7.	If this application is divided or otherwise derived from an earlier UK application, give the number and filing date of the earlier application	Number of earlier application / Date of Filing
8.	Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'YES' if:* *a) any applicant in 3. above is not an inventor, or* *b) there is an inventor who is not named as an applicant, or* *c) any named applicant is a corporate body)*	NO

Patents Form 1/77

9. Enter the number of sheets for any of the following items you are filing with this form. Do not count copies of the same document

Continuation sheets of this form	
Description	7
Claim(s)	2
Abstract	1
Drawing(s)	3

10. If you are also filing any of the following state how many against each item.

Priority documents	
Translations of priority documents	
Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	
Request for preliminary examination and search *(Patents Form 9/77)*	1
Request for substantive examination *(Patents Form 10/77)*	1
Any other documents	

11. I/We request the grant of a patent on the basis of this application.

Signature: Venner Shipley & Co

Date: 18 September 2002

12. Name and daytime telephone number of person to contact in the United Kingdom

JOHN WOODWARD
020 7600 4212

High G Oxygen Mask for Aircrew

This invention relates to an oxygen mask for use by pilot's who are subjected to high G forces.

Breathing equipment for aircrew normally comprises a flexible facemask having an inspiratory valve supplied with oxygen or some other breathable gas and an expiratory valve to allow the pilot to expel the air from the mask on exhalation. The facemask is attached to the pilot's flying helmet by means of a harness incorporating a releasable fitting.

In fighter aircraft, it is essential that the facemask makes a seal with the pilot's face at all times. Under normal flying conditions, this is not a problem as the pilot adjusts the harness tension so that the mask makes the necessary seal with his face and is also comfortable to wear. The supply of the breathable mixture through the mask is controlled by a breathing gas regulator which is responsive to the G-forces that it is subjected to. In other words, when the G-force increases, the pressure of the gas supply to the interior of the mask is correspondingly increased and vice-versa. Thus, changes in the G-forces applied to the regulator controlling the breathable gas supply result in automatic changes in pressure in the interior of the mask. It will be appreciated that unless some means is provided to maintain the seal between the mask and the pilot's face, any substantial increase in pressure within the mask cavity can cause the mask seal to leak so that the pilot will not receive the pressure of breathable gas he requires and he could therefore black out.

One known way of overcoming this problem has been to include an over-centre toggle in the harness assembly which attaches the mask to the pilot's helmet. This toggle is in a low-tensioned position for normal flight but, when the pilot wants to make a tight turn, he moves the toggle into its high tensioned position before the makes the turn which causes the facemask to be drawn more tightly against his face thereby improving the seal therewith.

After the turn is completed, he then releases the toggle. Indeed, he has to do this because the pressure exerted on his face when the toggle is engaged is so great that the mask is very uncomfortable to wear. The main problem with this arrangement is that the pilot must remember to engage the toggle before he makes a turn (possibly difficult in a combat situation) and release it after the turn has been completed as the pressure on his face is too high to be comfortable for normal flying.

In order to overcome these problems, the facemask disclosed in European patent No. 0541549 was developed and a breathing apparatus was provided in which the oro-nasal mask was mounted in a rigid shell attached to the pilot's helmet at a fixed distance therefrom, the oro-nasal mask including extendable means operable to cause the oro-nasal mask or a portion thereof to move automatically relative to the pilot's face to vary the seal therewith dependent on the pressurised breathable gas supplied to the mask.

In one embodiment of the mask in said earlier patent, the extensible means is an inflatable bladder located between the oro-nasal mask and the rigid shell. In another embodiment, the extensible means is located in the wall of the oro-nasal mask and comprises one or more folds or bellows. In both embodiments, when breathable gas at a pressure above that needed for normal breathing is supplied to the bladder or the interior of the oro-nasal mask, the bladder inflates or the bellows or folds extend to move the mask relative to the rigid shell in which it is mounted and thereby automatically vary the pressure of the mask on the pilot's face and its seal therewith dependent on the pressure of the breathable gas supplied to it. The essence of this solution is that the position of the rigid shell in which the oro-nasal mask is mounted and maintained at a fixed distance from the pilot's face and helmet so that the mask can be made to move relative to this fixed shell and therefore relative to the pilot's face to vary the seal the mask makes therewith dependent on the breathable gas pressure supplied to the mask.

According to the invention, there is provided a flexible oro-nasal mask for mounting in a rigid shell attached to the helmet of aircrew at a fixed distance therefrom, the flexible oro-nasal mask incorporating an inspiratory and expiratory valve and the periphery of the flexible mask being adapted to make a seal with the pilot's face, the oro-nasal mask including extendable means operable to press the periphery of the mask automatically towards the pilot's face to improve the seal therewith when gas at a pressure above that required for normal breathing is supplied to the mask and the extendable means reconfigure as a result thereof characterised in that the extendable means are configured so that when gas at a high pressure is supplied to the interior of the mask, the portion thereof in the bottom region of the mask extends more than the portion in the upper region of the mask so the bottom of the mask is moved away from the wearer's face by a greater amount in the chin region than the nose region and the mask pivots upwardly automatically to compensate for the effects of G thereon.

Preferably the extendable means comprises an annular inwardly directed recess formed in the wall of the mask adjacent the peripheral seal, the depth of said recess in the bottom half of the mask being greater than the depth in the top half thereof. Alternatively, a series of recesses can be formed in the mask wall to provide bellows therein.

In the preferred embodiment, the recess is V-shaped and comprises an inwardly directed flange on the front portion of the mask which is attached to a correspondingly dimensioned inwardly directed flange adjacent the peripheral seal on a separate rear portion of the mask.

The invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 is a side view of a prior art facemask in use with an aircrew helmet and breathable gas supply;

Figure 2A is a schematic view, on an enlarged scale, of part of the facemask shown in Figure 1, the oro-nasal mask mounted in the rigid shell being shown in dotted lines;

Figure 2B is a view similar to Figure 2A but showing the oro-nasal mask in its extended configuration;

Figure 3A illustrates schematically the configuration of the oro-nasal mask shown in Figure 2A prior to a high pressure breathable gas being supplied to the interior thereof;

Figure 3B is a view similar to that shown in Figure 3A but showing the mask after the high pressure breathable gas has been supplied to the interior thereof and the extendable means extended;

Figure 4A is a view similar to that shown in Figure 2A but illustrates the improved oro-nasal mask of the invention;

Figure 4B is a view similar to that shown in Figure 2B but with the oro-nasal mask of the invention in its extended condition;

Figure 5A illustrates schematically an alternative mask of the invention incorporating bellows in the wall thereof prior to a high pressure gas being supplied to the interior thereof;

Figure 5B is a view of the mask shown in Figure 5A after a high pressure breathable gas has been supplied to the interior thereof;

Figure 6A illustrates schematically another embodiment of mask of the invention incorporating a convoluted rolling section in the wall thereof prior to a high pressure breathable gas being supplied to the interior of the mask;

Figure 6B is a view of the mask shown in Figure 6A after a high pressure breathable gas has been supplied to the interior of the mask; and

Figure 7 is a cross section of the oro-nasal mask shown in Figure 4A taken along the lines VII-VII.

Referring now to the drawings, Figure 1 shows a pilot 1 wearing a rigid protective helmet 2. A flexible oro-nasal mask 3, usually made of a natural synthetic rubber, surrounds the pilot's nose and mouth and is mounted in a rigid plastics shell 4 attached to the helmet 2 by means of harness arrangement 5

which includes adjustable means (not shown) so that its length can be readily altered to ensure that the oro-nasal mask 3 rests comfortably on the pilot's face with its peripheral edge 10 making a proper seal with the area of the pilot's face surrounding his nose and mouth. It should be noted that the harness 5 is made of an inextensible material such as webbing or a metal wire mounted at mounting point P to the rigid shell 4 and at its opposite end in mounting 7 so that when the shell 4 and mask 3 are in position on the pilot's face, the position of the shell 4 relative to the helmet 2 cannot change and it remains at a fixed distance D therefrom (see Figures 2A and 2B).

A breathable gas such as oxygen is supplied to the interior of the mask 3 from an oxygen regulator 9 through hose 8.

Inspiratory and expiratory valves (not shown) are provided in the mask 3 in known manner.

As can be seen more clearly from Figure 2A, the wall of the mask 3 housed within the rigid shell 4 includes extendable means 11 therein. The purpose of the extendable means 11 is to enable the peripheral edge 10 of the mask 3 to move in a direction generally parallel to the wall of the rigid shell 4 when the pressurised breathable gas supplied to the interior of the mask 3 is increased as a result of the regulator 9 being activated when the aircraft makes a turn. When the pressure supplied to the interior of the mask 3 increases, the wall of the flexible mask 3 extends to cope with the increased pressure. As the wall cannot move radially outwardly because it is contained within the rigid shell 4, it can only move in a direction generally towards the pilot's face in the direction of the arrows (see Figure 2B) and thereby improves its seal therewith.

Figure 3A shows the mask 3 of Figure 2A in schematic form prior to the breathable gas being supplied to the interior of the mask 3 and with the re-entrant section 17 unextended. Figure 3B shows the mask of Figure 3A after the pressurised breathable gas has been supplied to the interior thereof and it can be

seen that the re-entrant section has extended and reconfigured to the illustrated shape so the edge 10 of the mask is moved in the direction of the arrows (see Figure 3B) towards the pilot's face to improve the seal therewith.

Whilst this prior art mask shown in Figures 1-3 worked satisfactorily when it was subjected to low to mid range G-forces, it was found that a problem could arise when high G-force turns were made because the high G-forces generated by the turn caused the rigid shell 4 and the oro-nasal mask housed within it to pivot about the mounting point P where the harness 5 is attached to the shell 4. As a result, the peripheral edge seal 10 with the pilot's face could not be maintained and accordingly the high pressure gas supplied to the interior of the mask 3 would leak out so the pilot would be starved of the required amount of breathable gas so he could black out.

Referring now to Figures 4A and 4B, there is shown an improved facemask of the present invention and it can be seen that the re-entrant section 11A in the top portion of the wall of the oro-nasal mask 3 which provides the extendable means is smaller than there-entrant section 11A in the bottom part of the mask than it is in the top. This is better illustrated in Figure 7 where it can be seen that the width D1 of the re-entrant section 11A at the top of the mask is less than the width D2 of the re-entrant section 11B in the middle region of the mask on either side of the pilot's nose which itself is narrower than the width D3 of the re-entrant section 11B of the mask at the bottom thereof in the chin region. Thus, the dimension D1 is less than D2 which is less than D3.

The effect of providing a variable sized re-entrant section as the extendable means in the wall of the facemask 3 is better shown in Figure 4B. When the breathable gas at high pressure is supplied to the interior of the mask 3, the extendable means 11 expand because the mask 3 cannot move relative to the shell 4, so the peripheral edge 10 is moved in the direction of the arrows towards the pilot's face. However, because the re-entrant section 11C in the bottom half of the mask 3 is larger than the re-entrant section 11A in the top part of the

mask and the edge 10 cannot move significantly further towards the pilot's face, the rigid shell 4 is pivoted upwardly as indicated by the arrow A (see Figure 4B) thereby compensating for the G-force acting on it which tends to push it downwardly in the direction of the arrow G. Accordingly, it will be seen that when the pilot makes a high G-force turn, the rigid shell 4 is automatically pivoted upwardly as the pressure of the breathable gas supplied to the interior of the mask 3 increases. Thus, the edge seal 10 is maintained with the pilot's face at all times during the turn so he is supplied with the required amount of high pressure breathable gas that he needs to avoid blacking out.

Figures 5A and 5B show another mask configuration which incorporates a bellows section 15 which extends into configuration 15A when a pressurised breathable gas is supplied to the interior thereof thereby causing the edge region 10 to move towards the pilot's face.

In the arrangement shown in Figures 6A and 6B, the mask 3 is housed within the rigid shell 4 as has already been described. The mask 3 has a convoluted rolling section 16 which is situated behind and adjacent edge seal 18 and accommodated in an enlarged section 17 of the rigid shell 4. As can be seen from the drawings, the thickness of the wall of the mask 3 in the region of the convoluted rolling section 41 is thinner than the remainder of the mask 3 thereby allowing it to be rolled back on itself into the S-shaped configuration illustrated. In its normal state, the mask 3 is contained within the shell enlargement 17. However, when the pressure of the gas supply to the interior of the mask 3 is increased, the convoluted rolling section 17 tends to unroll and the edge seal 10 is moved in the direction of the arrows thereby increasing the force applied by the edge seal 10 to the pilot's face thus preventing leakage.

Claims

1. A flexible oro-nasal mask for mounting in a rigid shell attached to the helmet of aircrew at a fixed distance therefrom, the flexible oro-nasal mask incorporating an inspiratory and expiratory valve and the periphery of the flexible mask being adapted to make a seal with the pilot's face, the oro-nasal mask including extendable means operable to press the periphery of the mask automatically towards the pilot's face to improve the seal therewith when gas at a pressure above that required for normal breathing is supplied to the mask and the extendable means reconfigure as a result thereof characterised in that the extendable means are configured so that when gas at a high pressure is supplied to the interior of the mask, the portion thereof in the bottom region of the mask extends more than the portion in the upper region of the mask so the bottom of the mask is moved away from the wearer's face by a greater amount in the chin region than the nose region and the mask pivots upwardly automatically to compensate for the effects of G thereon.

2. A mask as claimed in claim 1 wherein the extendable means comprises an annular inwardly directed re-entrant recess formed in the wall of the mask adjacent the peripheral seal, the depth of said recess in the bottom half of the mask being greater than the depth in the top half thereof.

3. A mask as claimed in claim 2 wherein the recess is V-shaped and comprises an inwardly directed flange on the front portion of the mask which is attached to a correspondingly dimensioned inwardly directed flange adjacent the peripheral seal on a separate rear portion of the mask.

4. A mask as claimed in claim 1 wherein the extendable means comprises a plurality of annular inwardly directed recesses formed in the mask wall to provide a bellows therein.

5. A mask as claimed in claim 1 wherein the wall of the mask includes a convoluted rolling section, the thickness of the mask wall in the region of the convoluted rolling section being less than the remainder of the mask thereby allowing the mask to be rolled back on itself into an S-shaped configuration.

Abstract

A flexible oro-nasal mask (3) for mounting in a rigid shell (4) attached to the helmet (2) of aircrew at a fixed distance therefrom. The flexible oro-nasal mask (3) incorporates an inspiratory and expiratory valve and the periphery of the mask is adapted to make a seal with the pilot's face. The oro-nasal mask (3) includes extendable means (11) which press the periphery of the mask automatically towards the pilot's face to improve the seal therewith when gas at a pressure above that required for normal breathing is supplied to the mask. The extendable means (11) are configured so that when gas at a high pressure is supplied to the interior of the mask, the portion (11C) in the bottom region of the mask (3) extends more than the portion (11A) in the upper region of the mask and the bottom of the mask is moved away from the wearer's face by a greater amount in the chin region than the nose region and the mask pivots upwardly automatically to compensate for the effects of G thereon. The preferred extendable means comprises an annular inwardly directed re-entrant recess (11) formed in the wall of the mask adjacent the peripheral seal (10), the depth of said recess in the bottom half of the mask being greater than the depth in the top half thereof.

(Figure 4A)

FIG.1

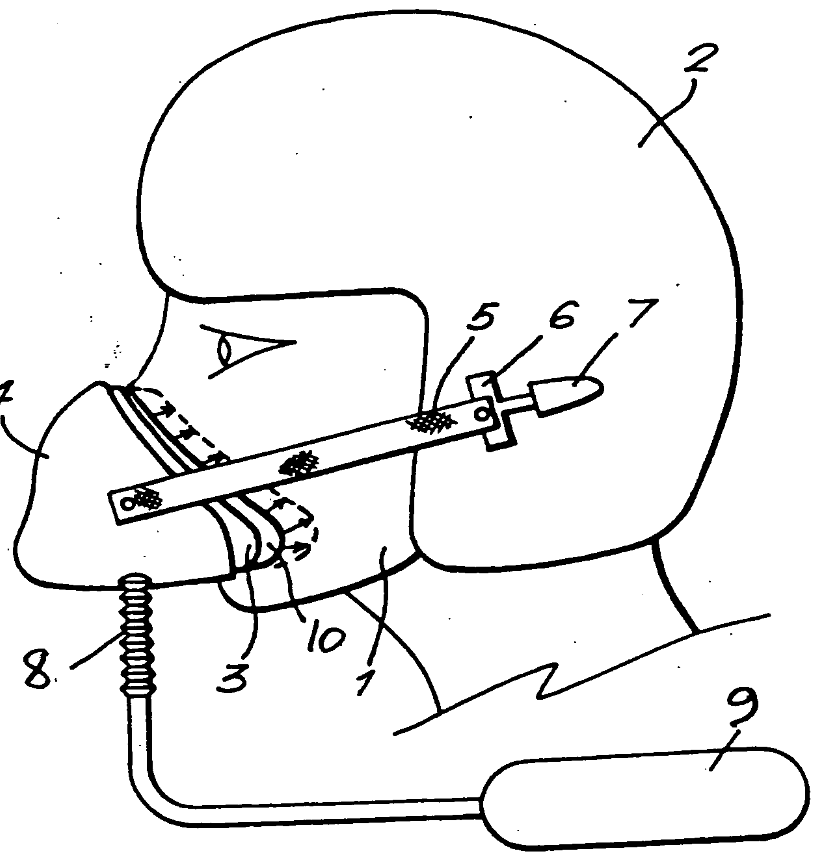

FIG2A

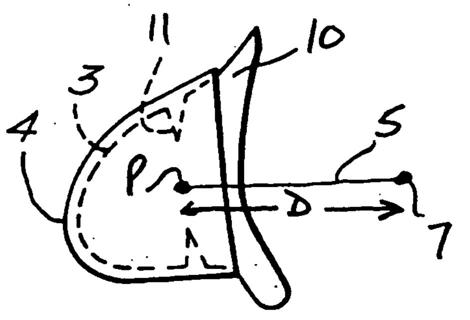

FIG2B

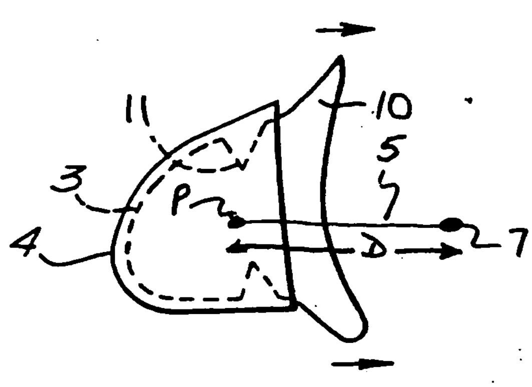

FIG3A.

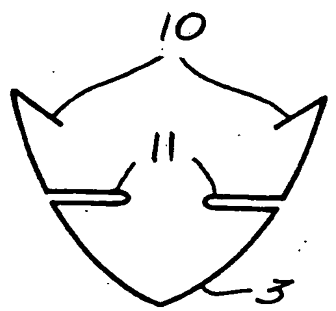

FIG3B.

FIG4A.

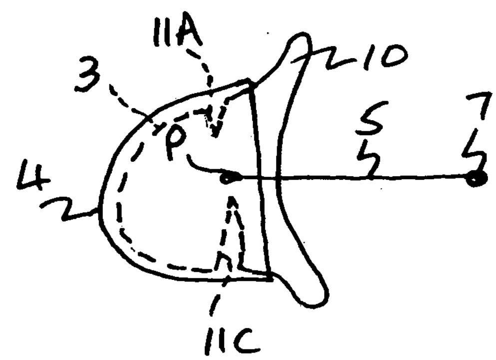

FIG4B.

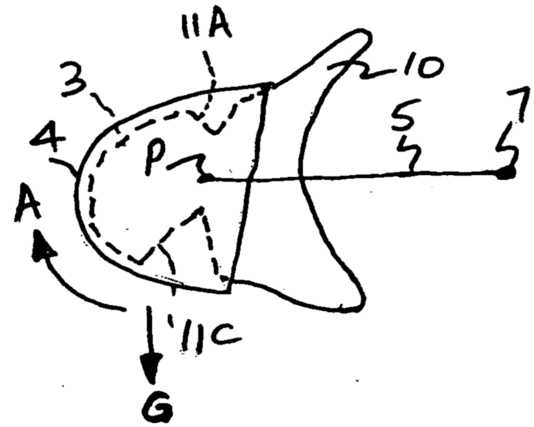

FIG5A.

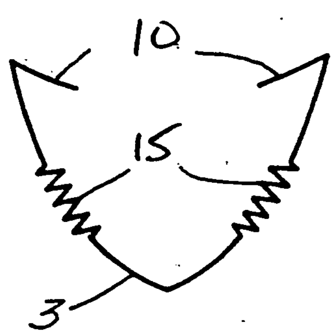

FIG5B.

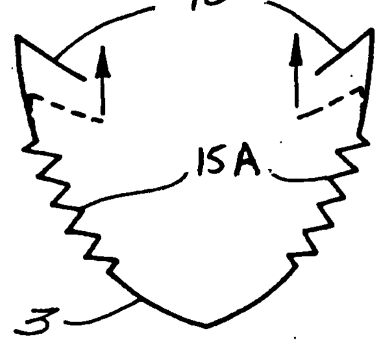

FIG 6A.

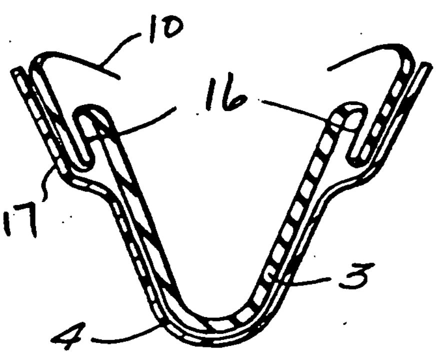

FIG 6B.

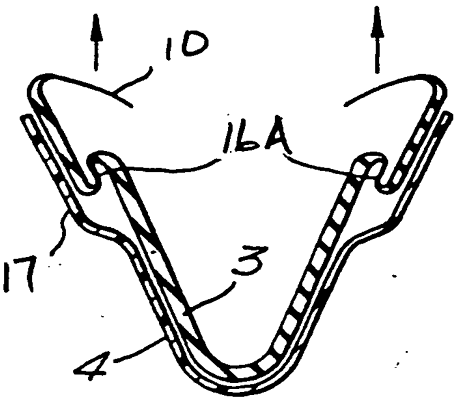

FIG. 7.